Implementing a Reuse Strategy Across Multiple Domains

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Foundations V&V in the 21st Century Workshop

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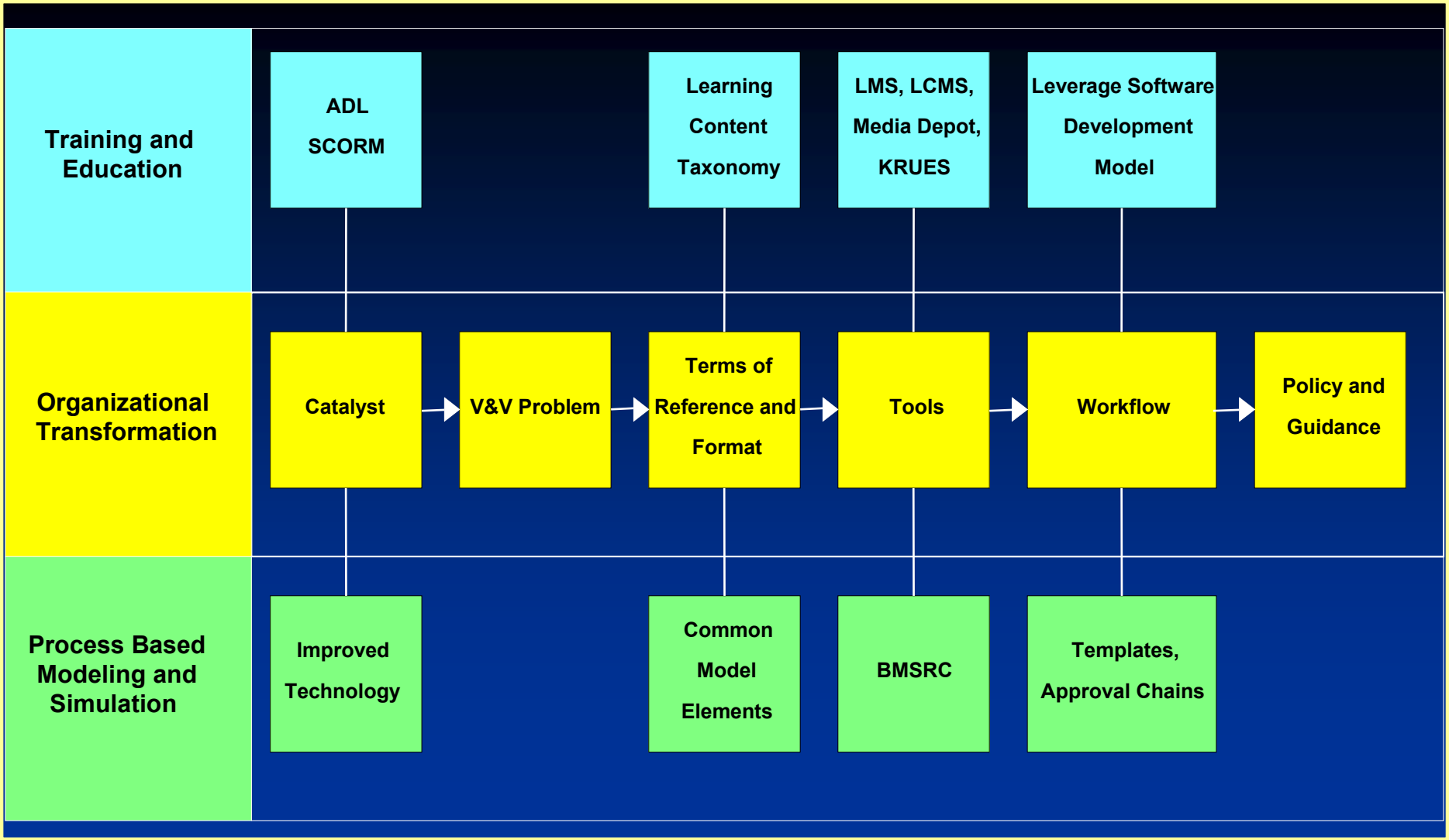
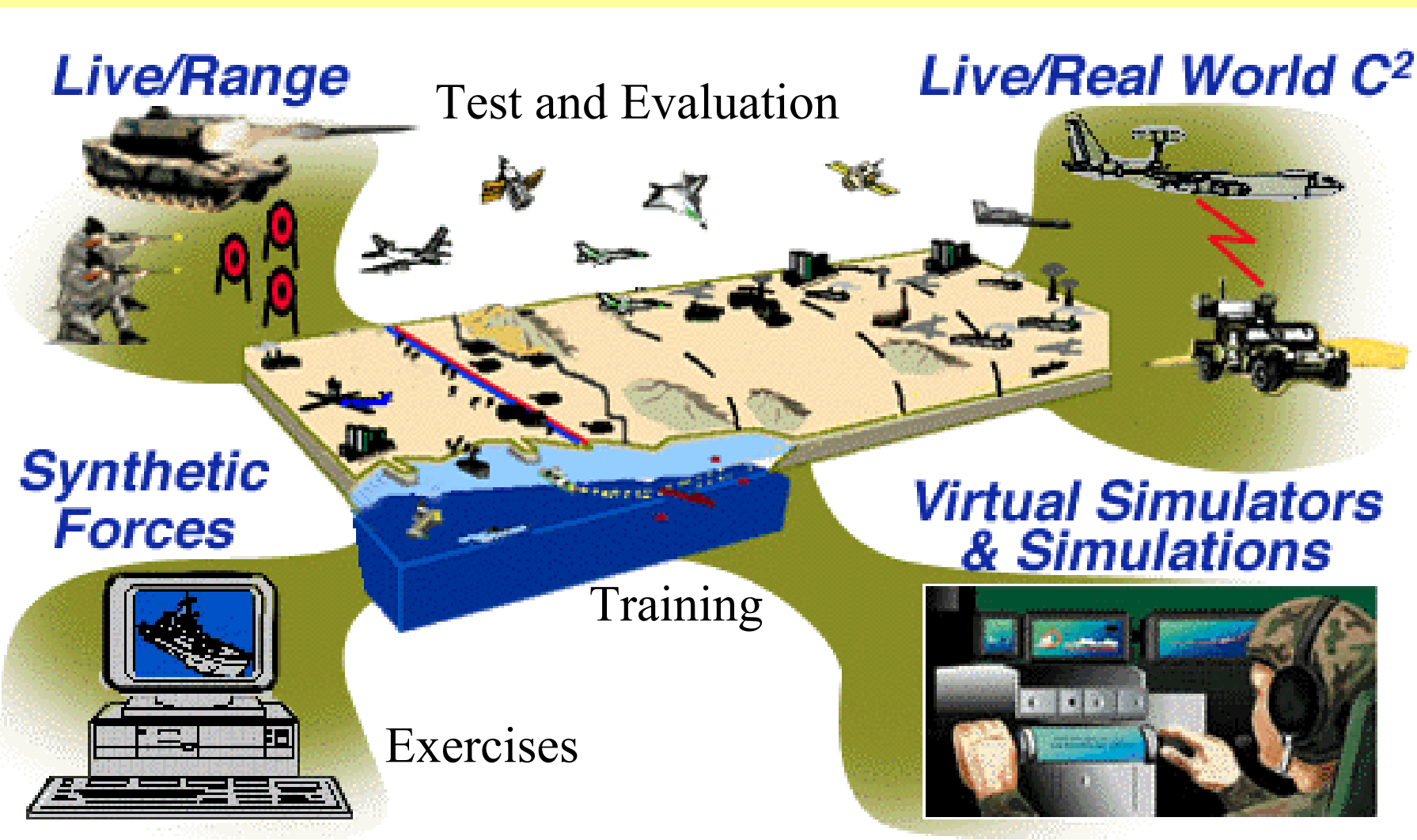
A Common Organizational Transformation Model



A New Environment

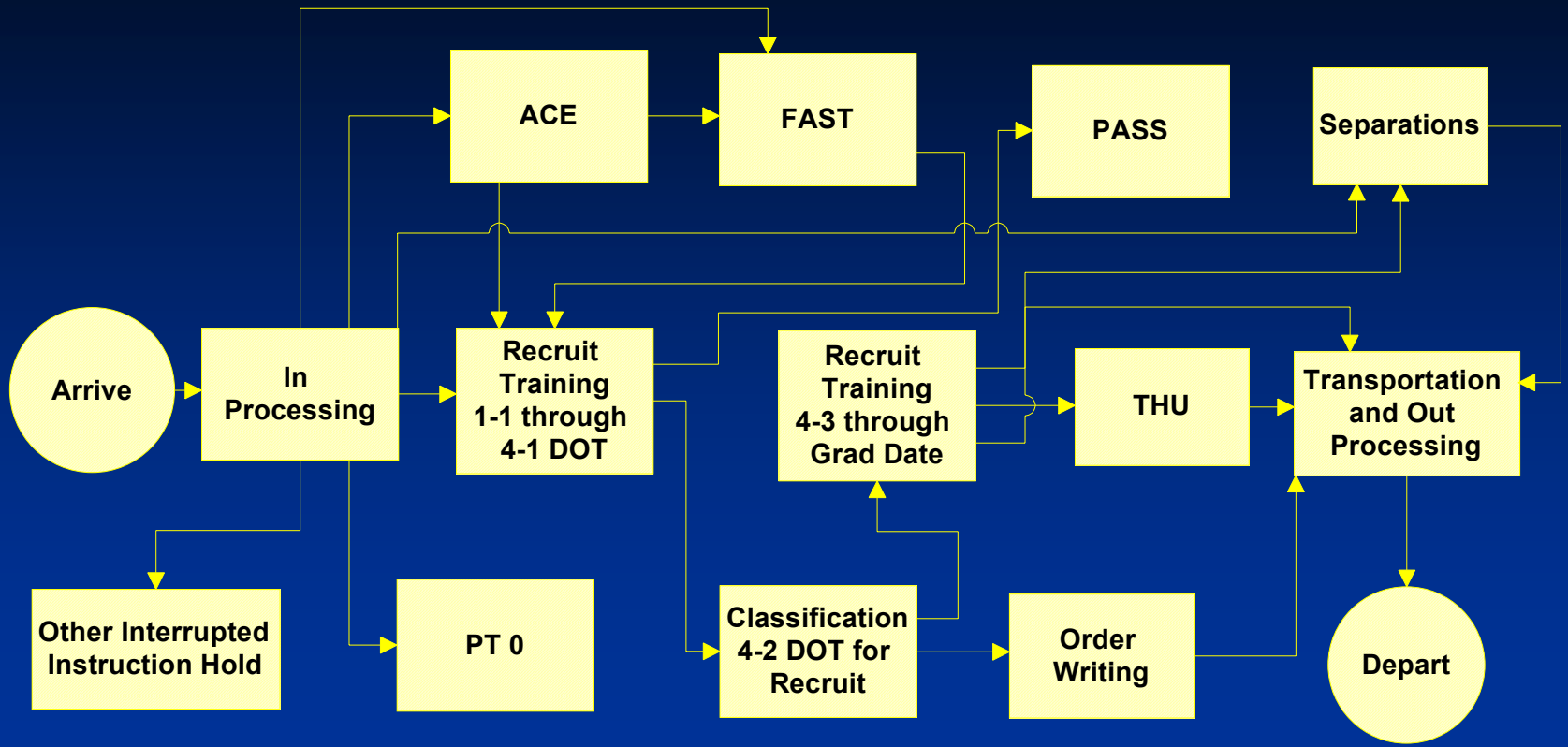
- Today's environment
  - Emphasis towards enterprise solutions
  - Reduce cost
  - Quickly evolving and changing technology
  - Reference models can withstand dynamic technology changes (conceptual design and context)
- Domains
  - DoD Modeling and Simulation (HLA)
  - Process-Based Modeling and Simulation (PBM&S)
  - Training and Education (SCORM)

Traditional M&S Domain



Emerging M&S Domain

Process-Based Modeling and Simulation



High Level Architecture (HLA)

- HLA is a flexible, reusable software architecture for creating component-based distributed simulations
- Developed to allow reuse of Defense simulations in different applications
- Conceived as general purpose architecture applicable beyond defense

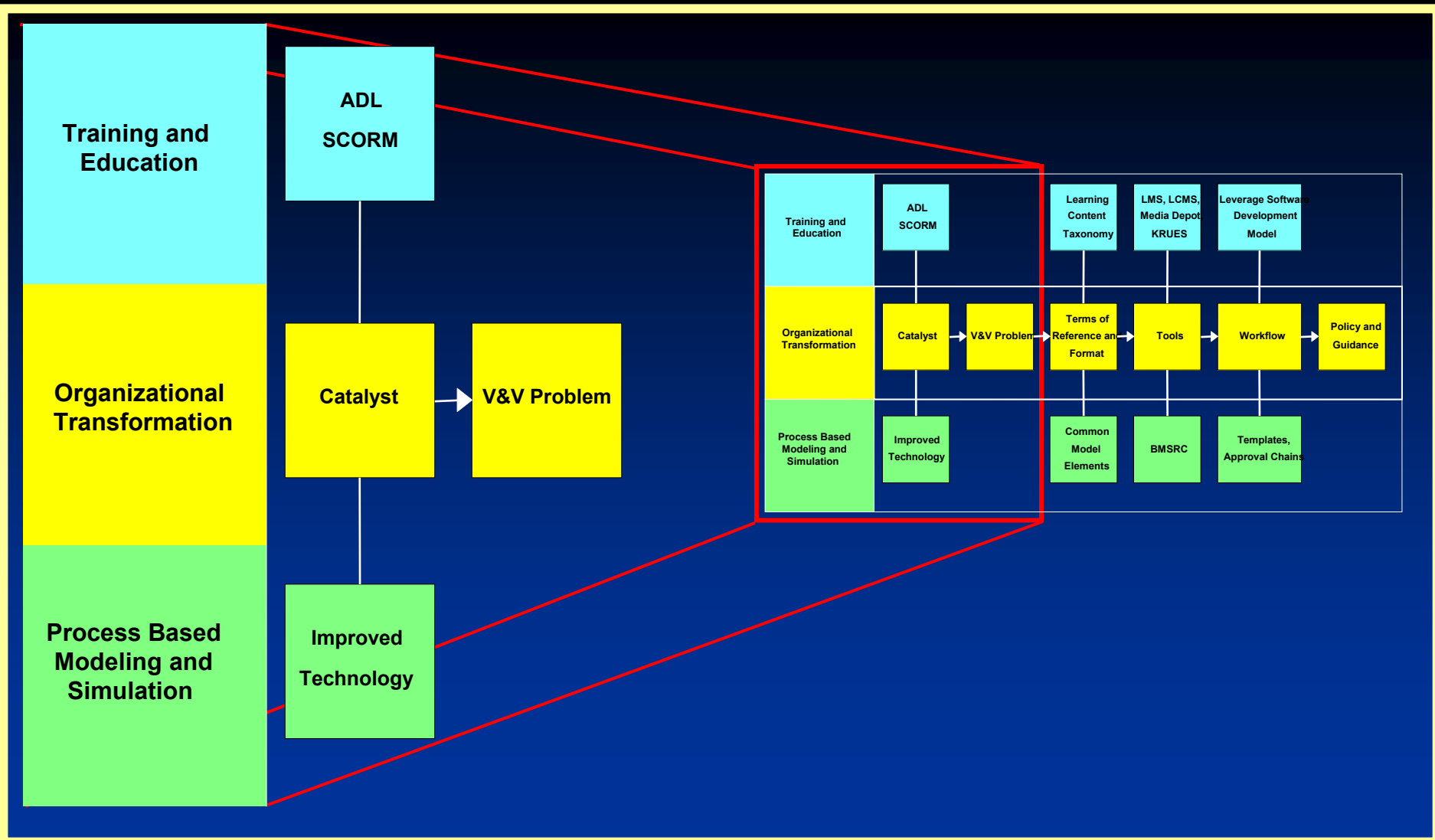
Advanced Distributed Learning Domain

- ADL has defined high-level requirements for learning content such as:
  - Content reusability
  - Accessibility
  - Durability
  - Interoperability
- The Sharable Content Object Reference Model (SCORM™) defines a reference model for sharable learning content objects that meet ADL high-level requirements

SCORM

- SCORM is a reference model that defines the interrelationship of course components, data models, and protocols such that content “objects” are sharable across systems that conform with the same model.
- Integration of industry specifications from
  - AICC
  - IMS
  - IEEE
- Provides a unified learning content model
- Is the first step on the path to defining a true learning architecture

Catalyst and VV&A Problem



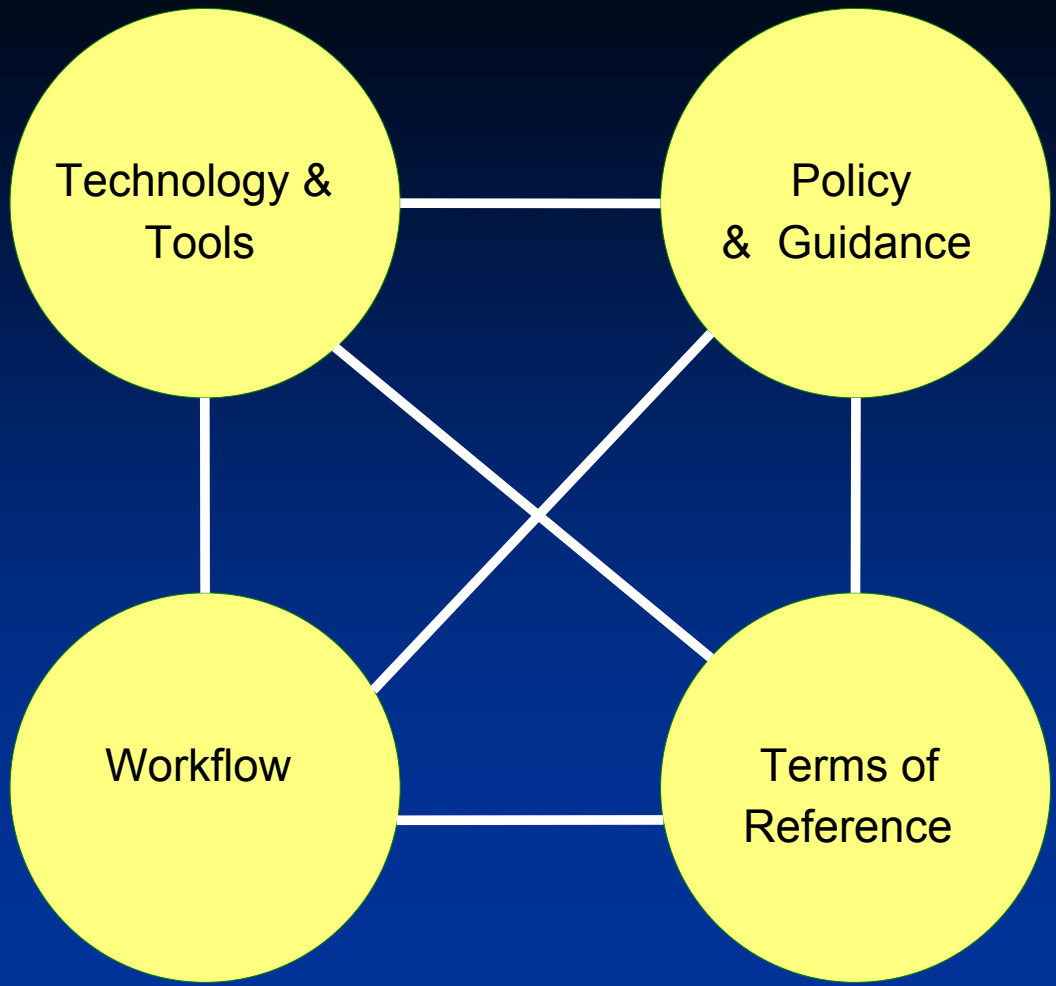
PBM&S Catalyst and Problem

- Catalyst
  - Technology improves drastically
  - Explosion of new, user friendly tools
  - Each tool has unique terminology and format
  - User base expands from OR/IE to managers
  - PBM&S expands from manufacturing to service industry
- Problems
  - Tacit knowledge buried in tool syntax/environment
  - VV&A complicated across multiple tools
  - Naive developers may not fully understand modeling concepts and results

ADL Catalyst and Problem

- Catalyst
  - SCORM requirements for content reusability, accessibility, durability and interoperability
- Problems
  - Few precedents in operationalizing reuse strategy
  - “Conformance” and “compliance” does not assure reusable or interoperable content
  - Very different user community
  - How do we know what we bought?

Enabling Organizational Transformation Framework



Process-Based M&S Example

- Each application uses unique terminology
- Flexibility in model development
- Data exports vary by application
- Client must learn application to validate model or “trust” modeler to validate own work
- Tacit knowledge is lost inside model software
- COTS discrete event simulation applications generally are not interoperable

Terms of Reference and Format

Process-based M&S Data Element Standardization

Collect Data Elements in a Common Format

Shape Name	Candidate for Decomposition	Input (Products Used)	Supplier	Who Performs /Roles	Data Sources and Systems to Perform	Business Rules

Focus on data and algorithm reuse instead of model reuse

Terms of Reference and Format

Process-based M&S Summary Report

Object Model Identification Table	
Category	**Information**
Name	
Version	
Date	
Purpose	
Application Domain	
Sponsor	
POC	
POC Organization	
POC Telephone	
POC Email	
Name	Strike Simulation SOM
Version	1.0 Alpha
Date	1 Jan 1998
Purpose	To provide an example of an object model for a federate that simulates strike operations.

HLA

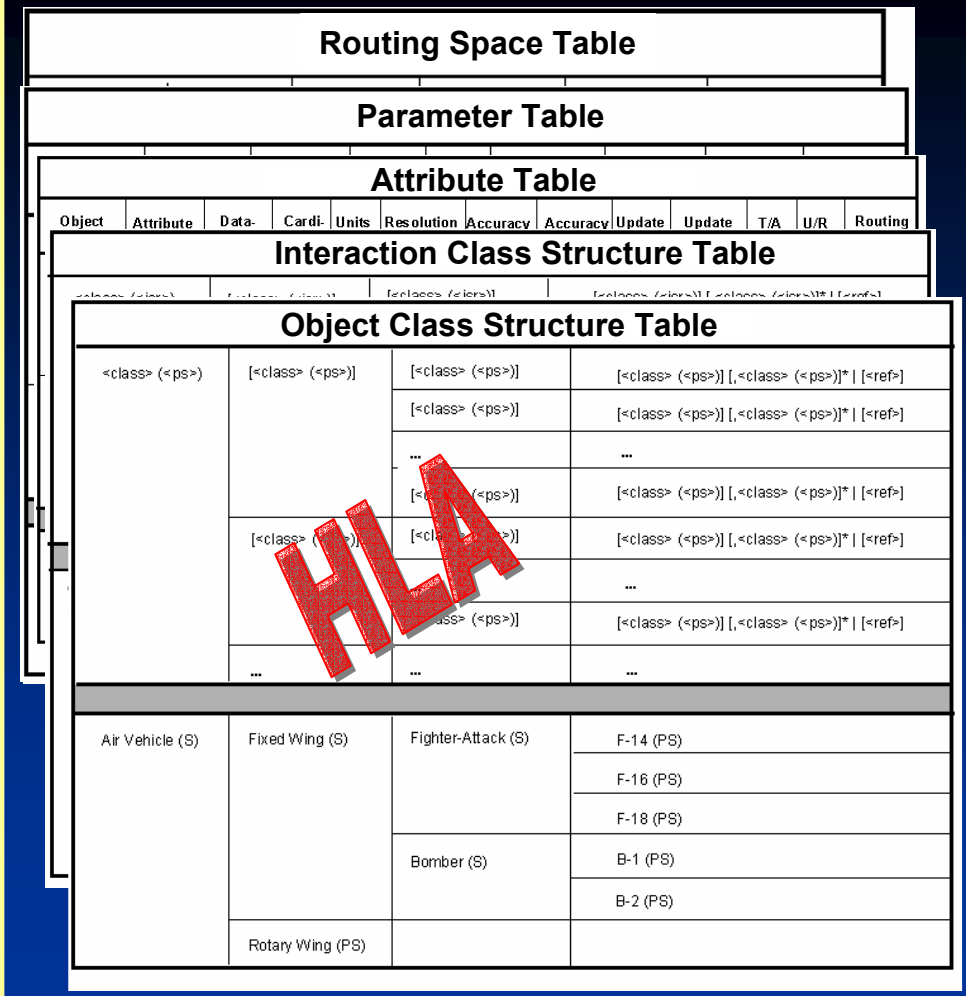
Summary Report

Model Name:
Application Domain:
Sponsoring Organization:
Last Revised Date:
Purpose of Model:
Introduction/Background:
Project Goal:
Model Metrics: Description, Goal
Primary Point of Contact:
Modeler:
Approval Authority (in process review order):
Model Assumptions:

Process-Based

Terms of Reference and Format

Process-based M&S Common Elements



Routing Space Table

Parameter Table

Attribute Table

Object	Attribute	Data-	Cardi-	Units	Resolution	Accuracy	Accuracy	Update	Update	T/A	U/R	Routing

Interaction Class Structure Table

Object Class Structure Table

<class> (<ps>)	[<class> (<ps>)]	[<class> (<ps>)]	[<class> (<ps>)] [,<class> (<ps>)]* | [<ref>]
		[<class> (<ps>)]	[<class> (<ps>)] [,<class> (<ps>)]* | [<ref>]
		...	...
		[<class> (<ps>)]	[<class> (<ps>)] [,<class> (<ps>)]* | [<ref>]
	[<class> (<ps>)]	[<class> (<ps>)]	[<class> (<ps>)] [,<class> (<ps>)]* | [<ref>]
			...
		[<class> (<ps>)]	[<class> (<ps>)] [,<class> (<ps>)]* | [<ref>]
	...	...	...
Air Vehicle (S)	Fixed Wing (S)	Fighter-Attack (S)	F-14 (PS)
			F-16 (PS)
			F-18 (PS)
		Bomber (S)	B-1 (PS)
			B-2 (PS)
	Rotary Wing (PS)		

HLA

Conceptual Validation Report

Unit of Behavior: the process events defined in the simulation model that entities travel through. This may include activities, locations, routings, waiting lines, etc

Resources: required object for processing at some point in the process. For example, instructors required to teach a class could be a resource.

Entities: the objects that move through the process and triggers events. For example, a sailor attending class could be the entity.

Operating Rules: specific business rule applicable to simulation model operation. These rules should describe model behavior, constraints, dependencies, and conditions.

Parameters: a user defined variable or attribute used in an operating rule.

Process Based

Tools and Workflow

Knowledge Capture and Reuse

- Problem:
  - Model and results look very different
  - No central place to share model information
  - No structured workflow for validation
  - One time use case mentality
- Solution:
  - Create web-enabled Business Modeling and Simulation Resource Center (BMSRC)
  - Promotes collaboration, model validation, knowledge management, and training

Tools and Workflow

BMSRC Web-based Tool

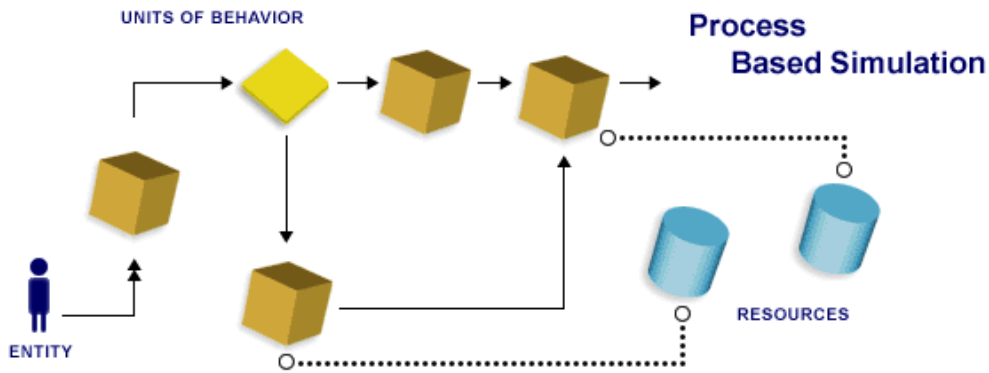
BMSRC

Business Modeling & Simulation Resource Center

Advanced Search

SEARCH GO

- ABOUT BMSRC
- BMSRC TUTORIAL
- DATA COLLECTION TOOLS
  - MODEL SUMMARY
  - UNITS OF BEHAVIOR
  - ENTITIES
  - RESOURCES
  - OPERATING RULES
  - PARAMETERS
- REPORTS
  - SUMMARY
  - VALIDATION
- DISCUSSION GROUP
- REFERENCE LIBRARY
- ADVANCE SEARCH
- REGISTER
- CONTACT
- SITE MAP
- HELP



The purpose of this resource center is to provide analysts with the information, tools, and resources to conduct, analyze, and validate business process analyses and simulation studies. The resource center is available to the public, however registration is required to use data collection and validation tools.

This U.S. Government system is subject to monitoring. Please review the Privacy & Security Notice.

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Policy & Guidance

New Guidance

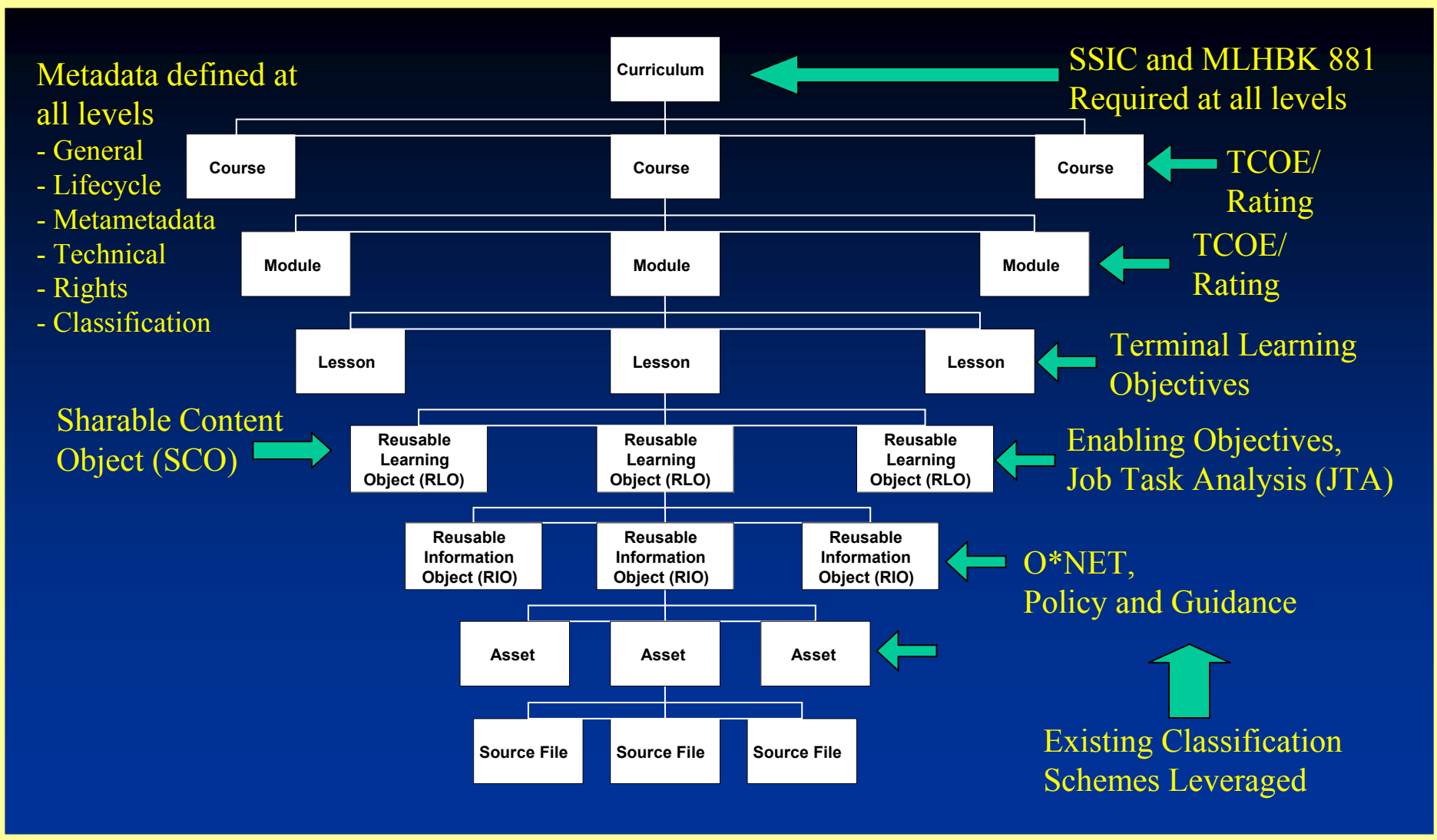
- Problem:
  - No PBM&S guidance for developers and procurement activities
- Solution:
  - OPNAV NOOT working with Navy Modeling and Simulation Office (NAVMSMO) to create a PBM&S standard

Training and Education Example

- SCORM is a radical departure from serial content development methods
- The SCORM has to be operationally defined and implemented for reuse to occur
- Instructional design community not familiar with the “object” oriented development environment
- How to specify product requirements, then test conformance

Learning Content Taxonomy

Common Terms of Reference



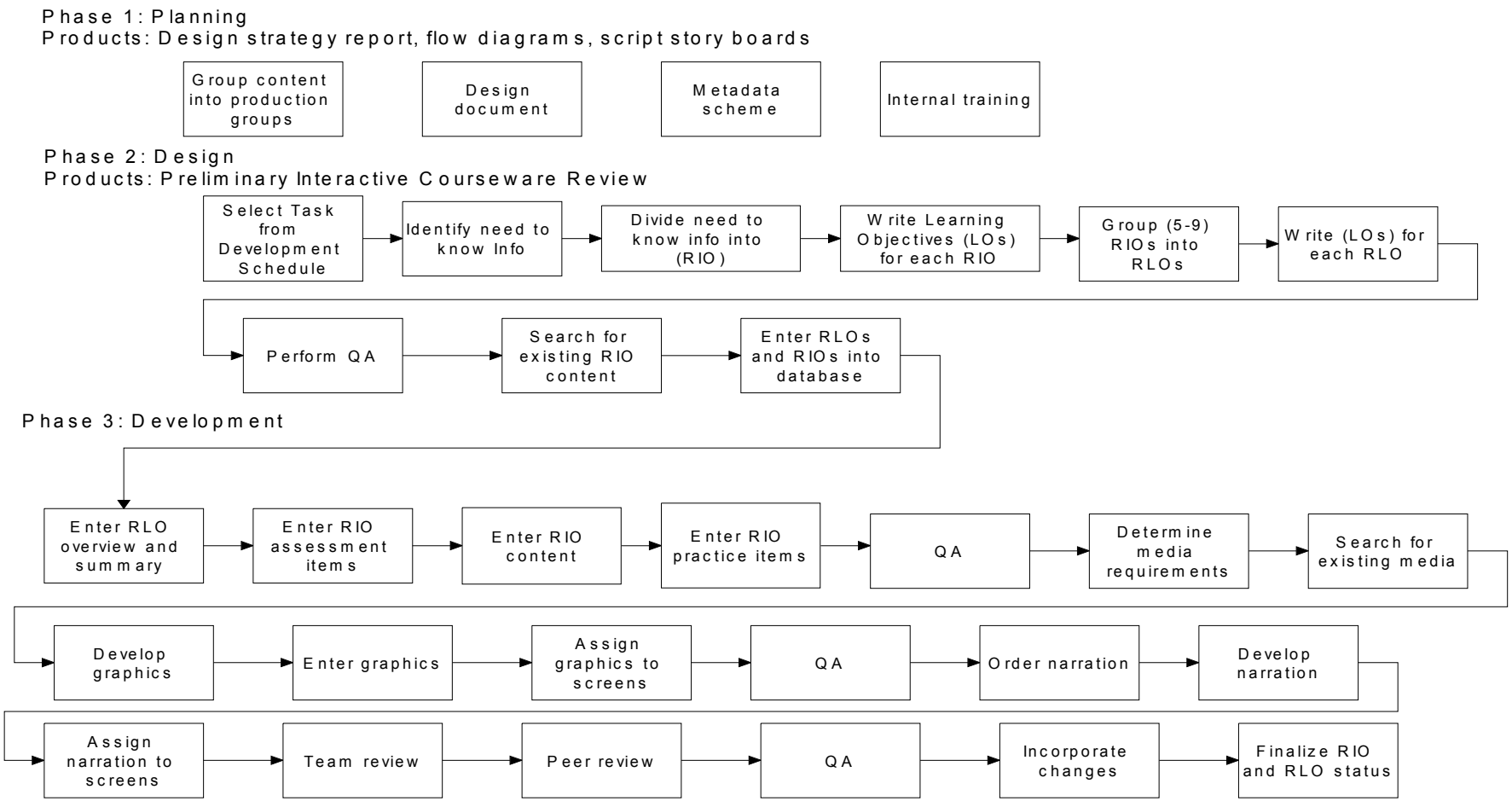
Content Management and Repositories

Tools & Technology

Type of Content	Typical Repository Technology	Typical User Perspective
Rich media, raw media	Digital Asset Management (DAM) Systems	Graphic Artist, media and publishing houses
Aggregated media in packaged formats	Content Management Systems (CMS)	Authors and publishers
Aggregated media in packaged formats (usually SCOs/RLOs)	Learning Content Management Systems (LCMS)	Instructional designers and curriculum managers
Assembled courses and lessons	Learning Management Systems (LMS)	Training managers and curriculum managers
Application packaged products (e.g. .doc, .ppt, .pdf, email) and pointers to other content	Portal	Knowledge manager/master

New Instructional Design Models

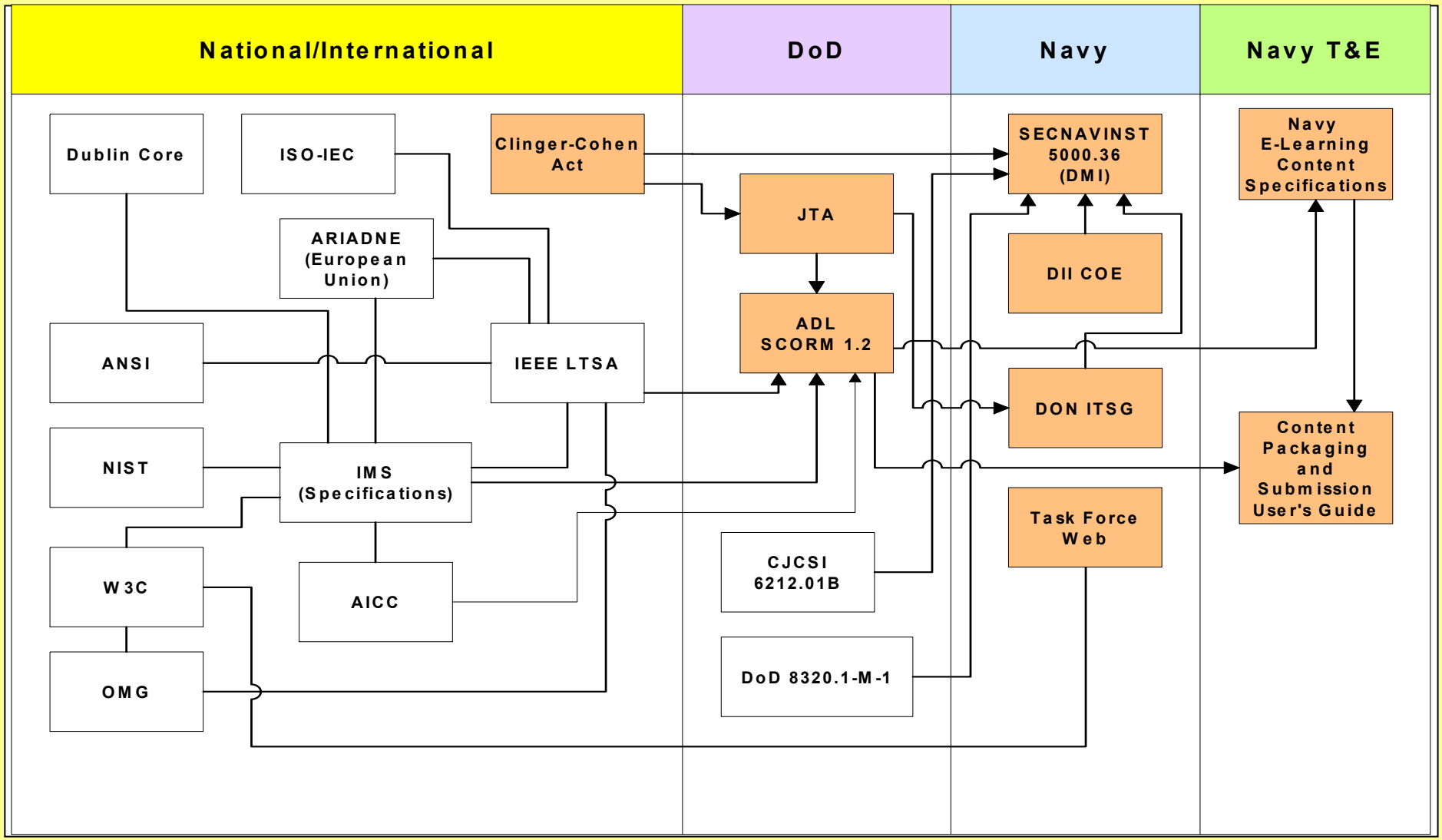
Workflow



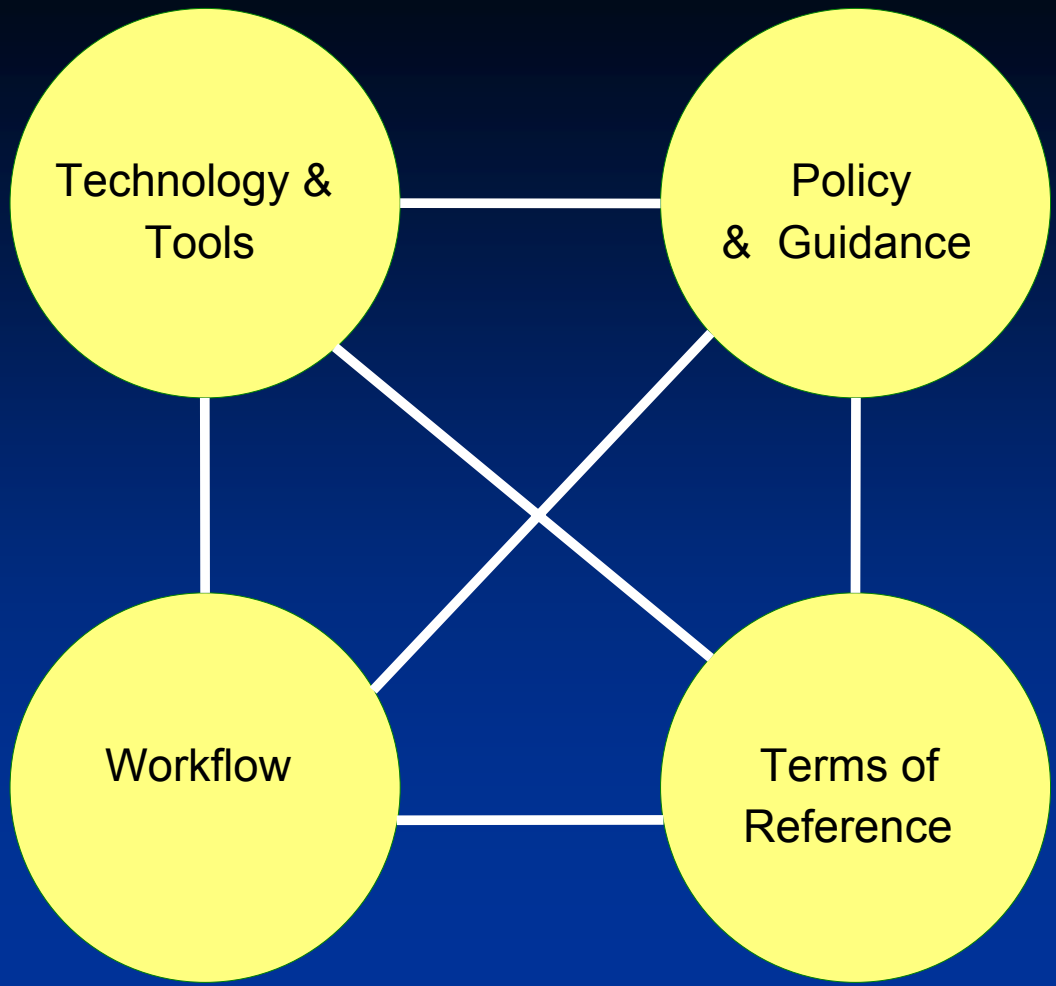
RIO: Reusable Instructional Object which is defined as either a fact, concept, principle, procedure, or process
RLO: Reusable Learning Object that consists of five to nine grouped RIOs

Rationalized Policy and Standards

Policy & Guidance



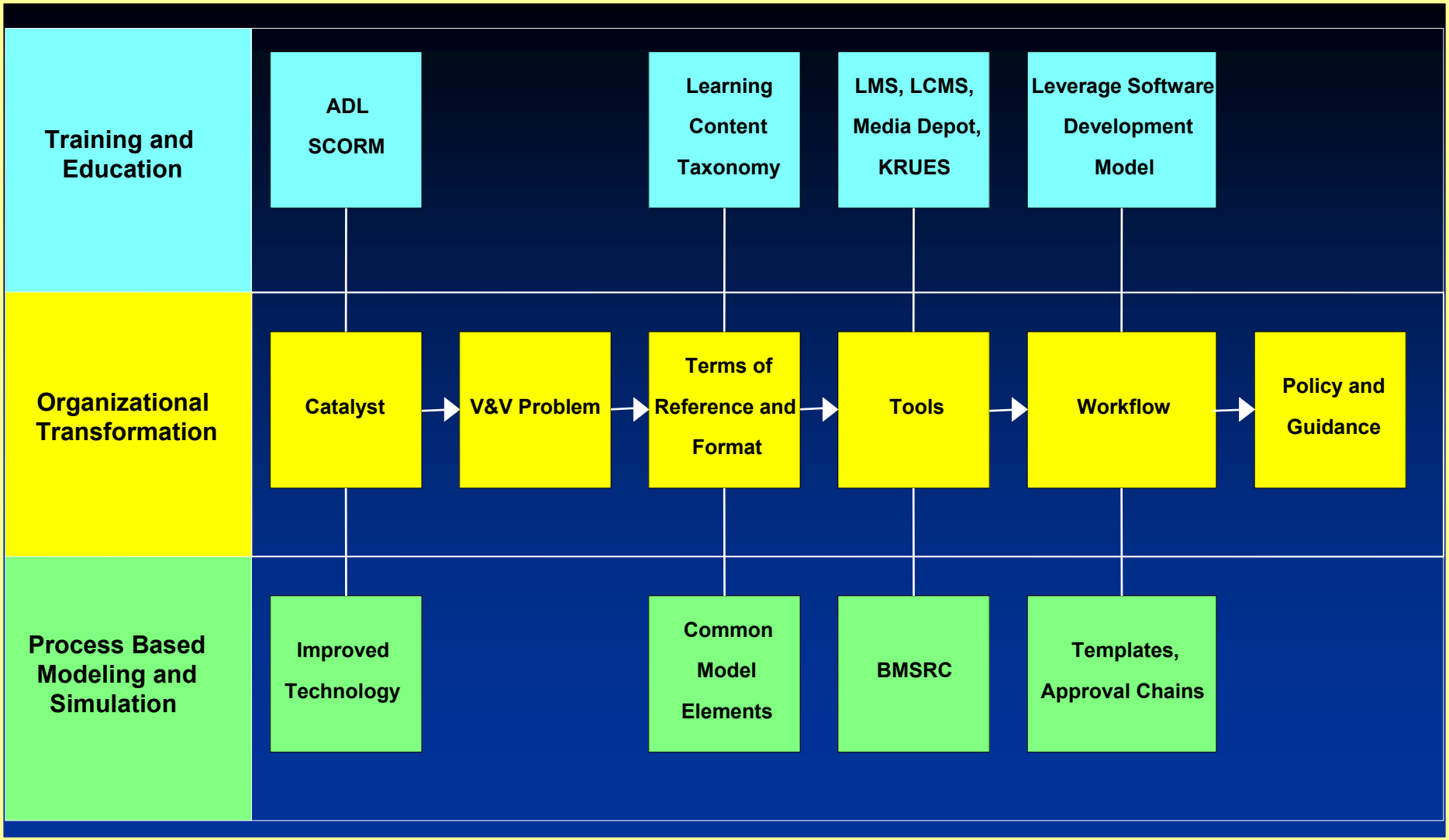
Synchronization is Key



VV&A Is More Important Than Ever

- Migration to “knowledge management”
  - Collection, classification, storage and retrieval of “knowledge objects”
  - Authoritative “object” sources
  - Object authentication, verification, validation, and accreditation
  - Object-based rapid development drives new workflow
- Many parallels between HLA implementation and SCORM implementation

Summary


Training and Education
ADL SCORM
Learning Content Taxonomy
LMS, LCMS, Media Depot, KRUES
Leverage Software Development Model
Organizational Transformation
Catalyst
V&V Problem
Terms of Reference and Format
Tools
Workflow
Policy and Guidance
Process Based Modeling and Simulation
Improved Technology
Common Model Elements
BMSRC
Templates, Approval Chains